

ON THE LIFE HISTORY OF A REPTILIAN TAPEWORM (*SPARGANUM REPTANS*)

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PLATE IX

The genus *Sparganum* was first proposed by Diesing (1854, 573) for those Pseudophyllidean cestodes the adult stages of which were unknown, and has included at various times *S. affine*, Diesing, 1854, *S. ardeae-coeruleae* (Diesing, 1850), *S. baxteri*, Sambon, 1907, *S. ellipticum*, Molin, 1858, *S. erinacei-europaei* (Rudolphi, 1819), *S. falconis* (Rudolphi, 1819), *S. lanceolatum*, Molin, 1859, *S. lanii-pomerani* (Rudolphi, 1819), *S. mansoni* (Cobbold, 1883), *S. mygales-moschatae* (Rudolphi, 1819), *S. proliferum* (Ijima, 1905), *S. railletii*, Rätz, 1913, *S. reptans* (Diesing, 1850), *S. sebago*, Ward, 1910, *S. strigis-accipitrinae* (Rudolphi, 1819). Most of these are probably synonyms, but the absence of diagnostic characters renders identification impossible except by feeding experiments. Of the above fifteen forms, only the life-histories of *S. mansoni* and *S. railletii* have been elucidated.

S. reptans is essentially parasitic in reptiles, occurring in the connective tissue and between the muscles—usually dorsal—of *Amphisbaena flavescens**, *Anabates lucinoides*, *Drymobius bifossatus* (Raddi, 1820), *Elaps marcgravi*, Wied, 1820, *Erythrolampus aesculapii* (L. 1754), *Herpetodryas carinata* (L. 1754), *Lachesis lanceolatus* (Jonnès, 1816), *L. newwiedii* (Wagl. 1824), *Leptophis liocerus* (Wied, 1824), *Oxyrhopus cloelia* (Daud, 1803), *Pseudophis*

* In consequence of the scanty literature at my disposal, it has proved impossible to check all the host names.

bivittatus, *P. cinerascens* and *Xenodon merremii* (Wagl. 1824). It has also been recorded from:—

AMPHIBIA: *Alcedo americana*, *Hydroscoptes plumbeus*, *Lyophis regius*, *Rhynaspis proboscidea*, *Spilotes pullatus*.

AVES: *Ardea coccoi*, *A. leuce*, *A. lineata*, *Corvus azureus*, *C. cristalellatus*, *C. cyanomelas*, *C. pileatus*, *Ibis albicollis*, *Merganser brasiliensis* (Vieill.), *Merula albiventer*, Spix, *M. rufiventris*, Vieill., *Molothrus ater* (Bodd.), *Muscicapa psalura*, *Nonnula rubecula* (Spix), *Nothocrax urumutum* (Spix), *Ostinops decumanus* (Pallas), *Pandion haliaëtus* (L.) *Rhamphastos temminckii*, *R. toco* (Müller), *Rhynchotus rufescens* (Temm.), *Strix grallaria*, *Tantalus loculator* (L.).

MAMMALIA: *Canis azarae*, Wied, 1826, *Chloroceryle americana*, *Chrysothrix sciurea* (L.1766), *Didelphys brachyura*, *D. opossum*, Seba, 1734, *Felis mitis*, Cuvier, 1820, *F. pardus*, L.1766, *F. tigrina*, Erxleben, 1777, *Galera barbara* (L.1766), *Gulo barbatus*, *Hapale melanura* (Geoffroy, 1812), *Holochilus brasiliensis* (Geoffroy, 1819), *Lutra brasiliensis*, Zimmermann, 1780, *L. paranensis*, Rengg, 1830, *Nasua narica* (L.1766), *Noctilio leporinus*, L.1766, *Saimiris sciurea* (L.1766).

All records, however, other than those from reptiles, should be regarded with suspicion, the absence of distinguishing characters rendering it probable that several species have been confused under one name.

S. reptans is an exceedingly common parasite in Burmese snakes. From one *Tropidonotus*, sp., twenty specimens were obtained, from another two, and from four more approximately fifteen each. With this material an attempt was made to discover the life-history. On January 20th, ten active specimens were given to a puppy a month old, and six to a human volunteer. On February 20th a further ten were given to the dog, who in the meantime had grown and fattened. He was killed on March 3rd, and was found to contain three adult *Dipylidium caninum*, three full-grown *Diphyllobothrium* and two scoleces of the same genus. The experiment is not conclusive as no time was available for previous faecal examinations of the animal nor for treatment with anthelmintics. Considering the youth of the dog and the absence of any records of Pseudophyllidea from Indian dogs, it is exceedingly improbable that the

Diphyllbothrium were present previous to the experiment. The presence of the worms produced in the animal no symptoms whatever. No trace of infection has been found in the faecal examinations of the human subject with the exception of a single egg, probably due to a contaminated slide. Attempts were made to ascertain if the life-history conforms to the type of *D. latum* and *D. mansoni* described by Rosen (1918) and Okomura (1919) respectively, but up to the present no procercoids have been found in the experimental Entomostraca.

PLEROCERCROID STAGE

The plerocercoid stage is usually to be found in small sacs on each side of the vertebral column between the skin and musculature of the dorsal surface, also amongst the connective tissue. It is motionless *in situ*, but upon being deposited in warm water becomes exceedingly active, wriggling in a manner reminiscent of a nematode. The scolex in particular performs active and regular movements. The tip is first protruded like a small tongue, becomes flattened while the sides swell up to form a truncated square pyramid, and is then retracted again, leaving a small pit at the apex of the pyramid. The whole anterior extremity subsides immediately, to repeat the same movements without pause. There is no definite scolex nor bothridia, only the mobile anterior extremity. The alleged terminal invagination is the result of contraction consequent upon fixation and, while probably performing the functions, has no trace of the structure of a sucker. External and internal segmentation is usually absent, but may occasionally in unusually long forms be represented by a few posterior transverse striations. The body is a slender ribbon with an anterior globular swelling, varying in length from 2 to 100 mm. and is capable of asexual reproduction by fragmentation but not by proliferation. In several cases strobilae were observed which were obviously the result of fragmentation and which were leading an independent existence. The internal anatomy showed nothing of note except the absence of 'nutritive bodies' described by Ijima (1905, 15) and myself (1924, 53) for *S. prolifer* and *Sparganum*, sp. respectively. In the absence of other distinctions it is possible that this character may be of use in identification.

ADULT FORM

Length 1000 mm. by 9 mm. wide, clearly segmented externally though with but little overlapping of the proglottides. Scolex (Pl. IX, fig. 1) elongated, 800μ long by 40μ wide, bearing two long shallow bothridia with indistinct edges, merging anteriorly and posteriorly into the scolex. Neck elongated. All segments broader than long. Musculature weak, consisting of a narrow and feeble layer of longitudinal muscles: transverse muscles could not be seen. Excretory vessels indistinct, consisting of four to eight longitudinal trunks on each side of the proglottis, connected by an extensive and complicated capillary system. Genital pores (Pl. IX, fig. 2) superficial, on same surface of proglottis. Male in anterior sixth, central: vaginal posterior to it and slightly lateral: uterine more posterior and central. Cirrus-sac extending half-way to opposite surface, external vesicula seminalis nearly reaching aporal cortical parenchyma. Testes in transverse sections 8 to 10 each side, in longitudinal vertical ones 9 to 11, total 144 to 220: in two separate lateral bands, slightly converging anteriorly. Ovary bi-lobed, reticulate. Shell-gland large, at posterior margin of proglottis. Vitelline glands lateral, converging and meeting anteriorly, and leaving free a central space one-twelfth to one-seventh of width of proglottis.

Eggs 53μ to 59μ by 36μ to 40μ , operculated: immature when deposited, onchosphere develops while egg lies in water.

From the characters just given, it may be seen that the adult of *S. reptans* belongs to the genus *Diphyllobothrium*. Altogether forty-seven species of this genus have been recorded, but the descriptions of only twenty-eight contain characters of diagnostic value, the remainder being concerned only with length and breadth of scolex and strobilus, shape of proglottides, etc.

An examination of the following table giving the species of this genus, indicates that well-marked features (distribution of testes, position and number of uterine coils, etc.) separate *D. reptans* from the majority of forms. From the remainder many may be separated by the size of the egg, a character liable to variation but only within fairly definite limits. *D. exile* and *D. fissiceps* have only been recorded once and are dubious species, while *D. nasuta* according to Fuhrmann

(1908, 95) should no longer be recognised. Minor differences separate *D. stemmacephalum* (shape of bothridia), *D. folium* (absence of neck and shape of proglottides), *D. rufum* (pigmentation of scolex) and *D. americanum* (absence of neck). These features are of slight value in themselves, but constitute the only distinguishing marks of the species. From *D. strigis-accipitrinae*, *D. decipiens*, *D. sulcatum*, *D. similis*, and *D. marginatus* the present form cannot be separated at all, owing to the absence of any description. The description of *D. clavatum* is not accessible here. It may, therefore, be concluded with reasonable accuracy, that *D. reptans* is a distinct species. The adult host remains to be discovered. The dog is obviously only an experimental host, the true one is probably a carnivore or an avian scavenger.

Specimens of adult and larval forms have been deposited in the Molteno Institute for Parasitology, Cambridge.

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Species	Genital pore	Uterine pore	Cirrus-sac	Testes	Uterine coils	Enlargement of uterus	Eggs (in μ)	Host
<i>D. americanum</i>	...	...	...	...	...	...	...	<i>Canis familiaris</i>
<i>D. arberti</i> ...	Half-way	Median	5 lobed internally	Scattered	...	...	...	<i>Ognorbinus coedelli</i>
<i>D. canadense</i>	Anterior	Median	...	150, 2 lateral fields joined anteriorly	8 to 10 each side	Absent, coils break down into sac	56 to 59 by 37 to 39	<i>Corvus corax principalis</i>
<i>D. clavatum</i>	...	...	...	...	...	...	...	<i>Ognorbinus coedelli</i>
<i>D. coarsi</i> ...	Anterior	Median	...	90, scattered	Absent, contain few eggs	Present	60	<i>Ognorbinus coedelli</i>
<i>D. conticeps</i> ...	Anterior	Median	Extends half-way between surfaces	...	...	...	...	<i>Pboca barbara</i>
<i>D. cordatum</i>	(Leuckart, 1863)	Median	...	240 to 300, 2 separate lateral bands	6 to 8, extending laterally to genital pore	...	70 to 80 by 50	<i>Canis familiaris, Homo sapiens, Pboca barbara, P. greenlandica, Trichechus rosomarus</i>
<i>D. cordeiceps</i> ...	(Leidy, 1872)	...	...	...	...	...	70 by 35	<i>Pelecanus erythrorhynchos</i>
<i>D. dectipiens</i>	(Diesing, 1850)	...	Extends half-way between surfaces	...	...	...	50 by 60	<i>Canis familiaris, C. lupus, Felis canis, F. concolor, F. domestica, F. macroura, F. mellivora, F. mitis, F. onca, F. pardus, F. nigra, mellivora rasil</i>
<i>D. dendriticum</i>	(Nitzsch, 1824)	...	...	470, 2 lateral fields joined anteriorly	8 to 9	...	...	<i>Larus argentatus, L. canis, L. ridibundus, Rissa tridactyla</i>
<i>D. ditremum</i>	(Creplin, 1825)	...	...	380 to 390, 2 lateral fields joined posteriorly and anteriorly	7	...	...	<i>Larus argentatus, Mergus mer-ganser, M. serraator, Urinator arcinus, V. stellatus</i>

Species		Genital pore	Uterine pore	Cirrus-sac	Testes	Uterine coils	Enlargement of uterus	Eggs (in μ)	Host
<i>D. elegans</i>	(Krabbe, 1865)	...	...	...	...	...	...	44 by 35	<i>Cystophora cristata</i> , <i>Eumetopias jubata</i> , <i>Pboca vitulina</i>
<i>D. exile</i>	(Linton, 1892)	...	...	...	...	...	...	...	<i>Larus californicus</i>
<i>D. fissiceps</i>	(Creplin, 1829)	...	...	...	...	...	...	...	<i>Sterna hirundo</i>
<i>D. folium</i>	(Diesing, 1850)	...	...	...	...	...	...	...	<i>Herpestes albicaudus</i>
<i>D. fuscum</i>	(Krabbe, 1865)	...	...	...	...	5 to 7 (Railliet 10 to 12), lateral to male genital pore	...	55 to 60, non-operculated	<i>Canis familiaris</i>
<i>D. bias</i>	(Diesing, 1850)	Cirrus posterior to vagina (Ariola)	...	...	...	...	...	59 by 38	<i>Monachus albiventer</i> , <i>Pboca barbata</i> , <i>P. hispida</i> , <i>P. vitulina</i>
<i>D. lanceolatum</i>	(Krabbe, 1865)	Anterior quarter	...	...	180 to 312, 2 separate fields	5 to 7, lateral to male genital pore	...	55 to 60 (Zschokke and Heitz 62 by 40)	<i>Pboca barbata</i>
<i>D. lasbleyi</i>	(Leiper and Atkinson, 1914)	Anterior	Lateral	...	2 separate lateral bands with 2 posterior ones	Simple	...	60	<i>Ogmorbinus weddelli</i>
<i>D. latum</i>	(L. 1758)	Anterior quarter	Median	Extends half-way between surfaces	2 separate lateral bands	Numerous, extending laterally to genital pore	Absent	67 to 70 by 48 to 54	<i>Canis azarae</i> , <i>C. familiaris</i> , <i>Cystophora cristata</i> , <i>Felis concolor</i> , <i>F. domestica</i> , <i>F. bernandesii</i> , <i>F. macroura</i> , <i>F. mellivora</i> , <i>F. mitis</i> , <i>F. pardus</i> , <i>F. tigrina</i> , <i>Herpestes leucurus</i> , <i>Homo sapiens</i> , <i>Leptonyx monachus</i> , <i>Odobaeus rosmarus</i> , <i>Pboca barbata</i> , <i>P. hispida</i> , <i>P. vitulina</i> , <i>Pbocaena pbocaena</i> , <i>Ursus maritimus</i> , <i>Vulpes lagopus</i> , <i>V. vulpes</i>

Species	Genital pore	Uterine pore	Cirrus-sac	Testes	Uterine coils	Enlargement of uterus	Eggs (in <i>n</i>)	Host
<i>D. macroballus</i> ...	(Linstow, 1905)	...	...	...	...	...	...	<i>Otaria ursina</i> , <i>Pboca barbata</i>
<i>D. mansoni</i> ...	(Cobbold, 1882)	...	...	...	...	...	63 to 76 by 31 to 43	<i>Canis familiaris</i>
<i>D. marginatus</i> ...	(Krefft, 1871)	...	...	...	...	...	...	<i>Halmaturus</i> , sp.
<i>D. mobilis</i> ...	(Rennie and Reid, 1912)	Anterior	Lateral	2 bands joining anteriorly	3 to 6	Fuhrmann 56 to 60 by 44 (Rennie and Reid 51 by 34)	...	<i>Ognorbinus weddelli</i>
<i>D. nasuta</i> ...	(Rudolph, 1802)	...	...	...	...	...	...	<i>Parus major</i>
<i>D. parvum</i> ...	(Stephens, 1908)	Like <i>D. latum</i>	...	...	...	...	...	<i>Homo sapiens</i>
<i>D. perforatum</i> ...	(Railliet and Henry, 1912)	...	Lateral	Extends between half-way surfaces	Only one coil with eggs	Fuhrmann 60 to 64 by 45 to 48 (Railliet and Henry 56 to 64 by 43 to 45)	48 by 32	<i>Ognorbinus weddelli</i>
<i>D. polycalceolum</i> ...	(Ariola, 1896)	Anterior sixth	...	...	8 to 9, not lateral to genital pore	...	...	<i>Pboca vitulina</i>
<i>D. podicipedis</i> ...	(Diesing, 1854)	...	...	...	...	...	...	<i>Podiceps minor</i> , <i>P. rubricollis</i>
<i>D. pygocelis</i> ...	(Rennie and Reid, 1912)	Very anterior	...	Scattered over proglottis	6 to 7	64 to 80 by 50 to 52	...	<i>Rygoscelis</i> , sp.
<i>D. quadratum</i> ...	(Linstow, 1891)	Anterior quarter	Median	Extends half-way between surfaces	6 to 7	54 by 44 (Fuhrmann 50 by 43)	Present	<i>Ognorbinus leptonyx</i>
<i>D. raillieti</i> ...	(Ratz, 1913)	...	Median	Small	300 to 500, 2 separate fields	62 to 70 by 37 to 54	Present	<i>Canis familiaris</i>
<i>D. resinum</i> ...	Railliet and Henry 1912	...	...	...	...	...	...	<i>Ognorbinus leptonyx</i>
<i>D. romeri</i> ...	(Zschokke, 1903)	Anterior fifth	Median	To aporal surface	600 to 1000	6 to 8, lateral to genital pore	62 by 39	<i>Trichechus rosomarus</i>

Species	<i>D. rufum</i> (Leiper and Atkinson, 1914)	<i>D. scbitocbilos</i> (Germanos, 1895)	<i>D. scotii</i> (Shipley, 1907)	<i>D. scoticum</i> (Rennie and Reid, 1912)	<i>D. semiligula</i> (Nitzsch, 1824)	<i>D. serratum</i> (Diesing, 1850)	<i>D. stimpis</i> (Krabbe, 1865)	<i>D. spiraliiceps</i> (Volz, 1900)	<i>D. stemmacephalum</i> ... Cobbold, 1858	<i>D. sulcatum</i> (Möln, 1858)	<i>D. tectum</i> (Linstow, 1892)	<i>D. wilsoni</i> (Shipley, 1907)	<i>D. reptans</i> (Diesing, 1854)
Genital pore	...	...	...	...	...	...	Uterine and genital pores one either side	...	...	...	Anterior quarter	Median lateral or lateral	Half-way between surfaces
Uterine pore	...	...	Lateral	Lateral	...	...	...	...	...	...	Lateral or median	Half-way between surfaces	Half-way between surfaces
Cirrus-sac	...	...	...	...	...	...	...	...	...	...	To medullary parenchyma	Half-way between surfaces	Half-way between surfaces
Testes	...	...	4	5 to 6	...	...	...	...	...	...	...	...	144 to 220, 2 separate bands
Uterine coils	...	...	...	5 to 6	...	...	...	...	...	...	...	...	4, not lateral to genital pore
Enlargement of uterus	...	...	Present	...	...	...	...	...	...	...	...	...	Present
Eggs (in μ)	25	50 to 70 by 20 to 30	Shipley 40 by 30, Ommatopboca rossii	70 to 80 by 44 to 48	...	64 by 40	...	36 by 32	...	...	65 by 47	(Führmann 48 to 52, Rennie and Reid 52 to 60 by 32 to 36)	53 to 59 by 36 to 40
Host	<i>Ogmorbiniis cweddelii</i>	<i>Pboca barbara</i>	<i>Ommatopboca rossii</i>	<i>Ogmorbiniis leptonyx</i>	<i>Podiceps rubricollis</i>	<i>Canis azarav, C. familiaris</i>	<i>Vulpes lagopus</i>	<i>Falco concolor</i>	<i>Pbocaena pbocaena</i>	<i>Felis pardus</i>	<i>Macrorbiniis leoninus</i>	<i>Ogmorbiniis cweddelii, Ommatopboca rossii</i>	<i>Canis familiaris</i>

EXPLANATION OF PLATE IX

FIG. 1. *D. reptans* : scolex.

FIG. 2. *D. reptans* : mature proglottis. *c.s.*, cirrus-sac ;
m., male pore ; *ov.*, ovary ; *t.*, testes ; *u.*, uterus ;
v., vagina ; *v.*¹, vaginal pore ; *vit.*, vitellaria.

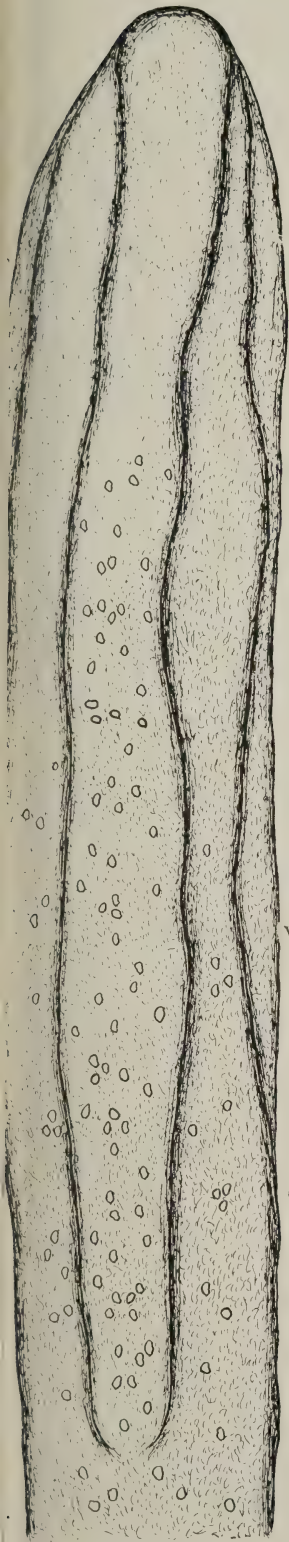


FIG. 1

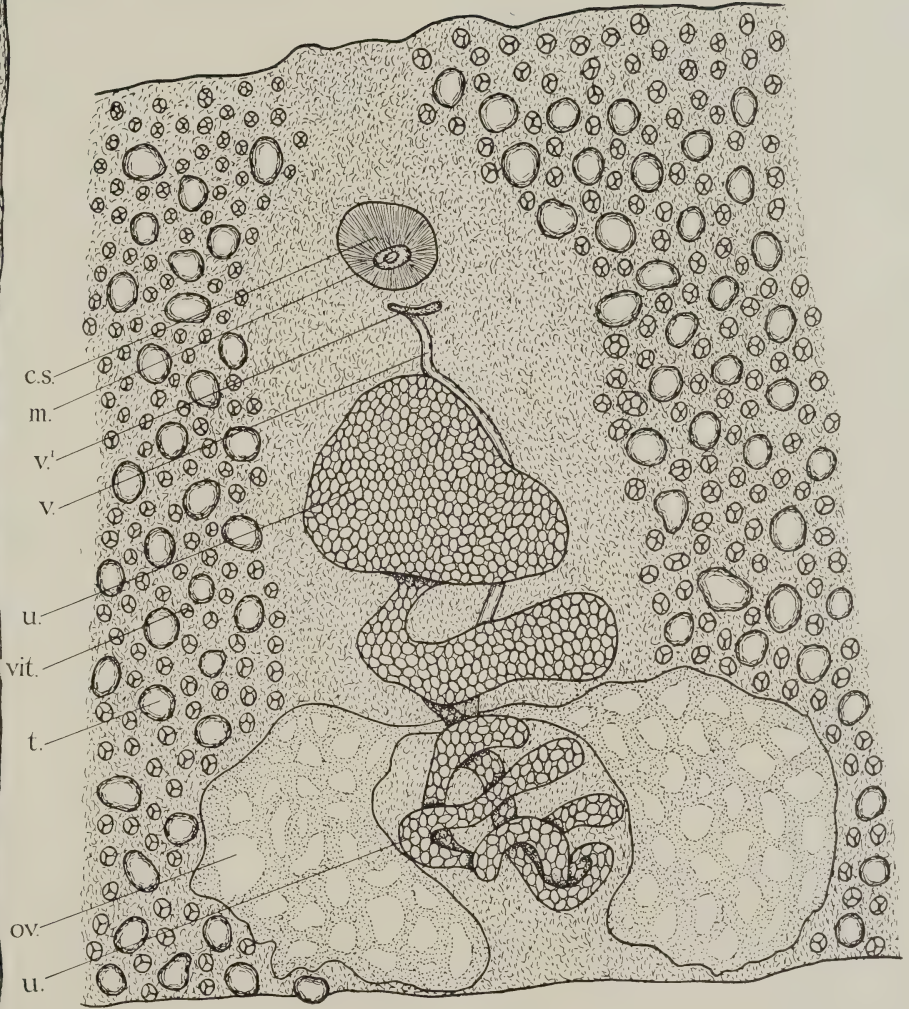


FIG. 2